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ACHIEVE

Advanced CETO for High Impact and Efficiency Validation in Europe

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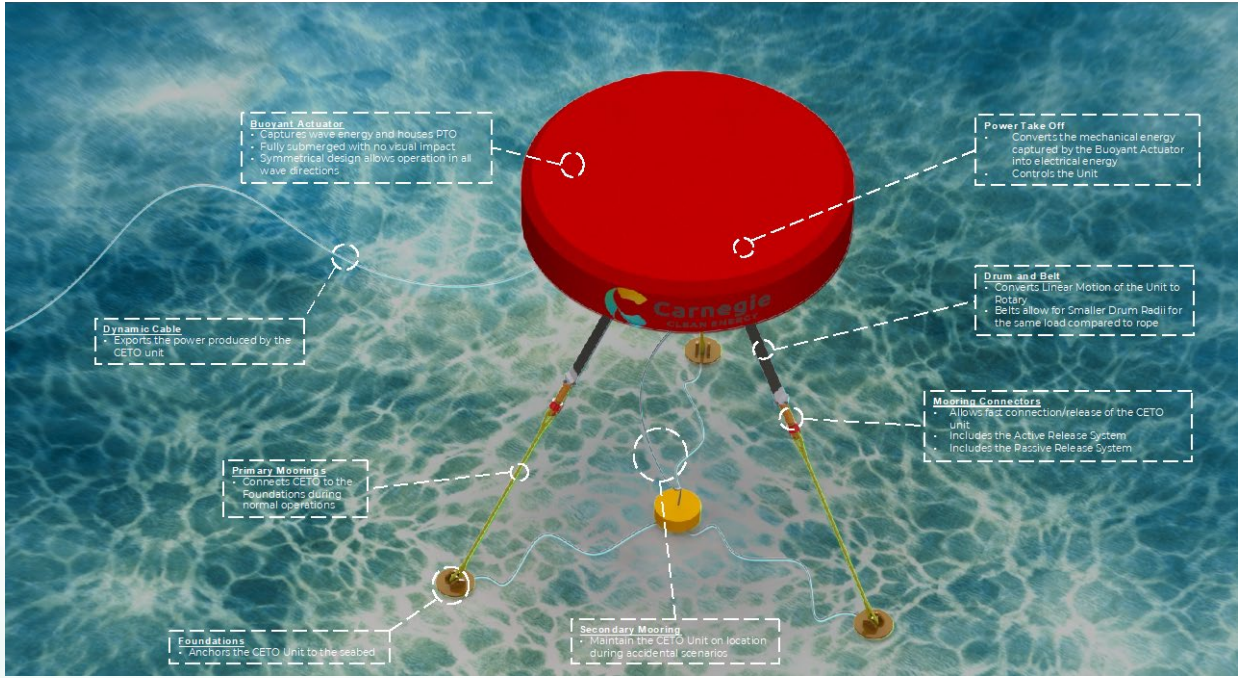
CETO WAVE ENERGY IRELAND

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement 883751.

CETO Technology – Key Features

- Point Absorber
- Axisymmetric
- Submerged
- Multi-moored
- Scalable
- Adapts to various depths
- Optimised for lowest LCOE
- Survivability



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CETO Technology – Key Features

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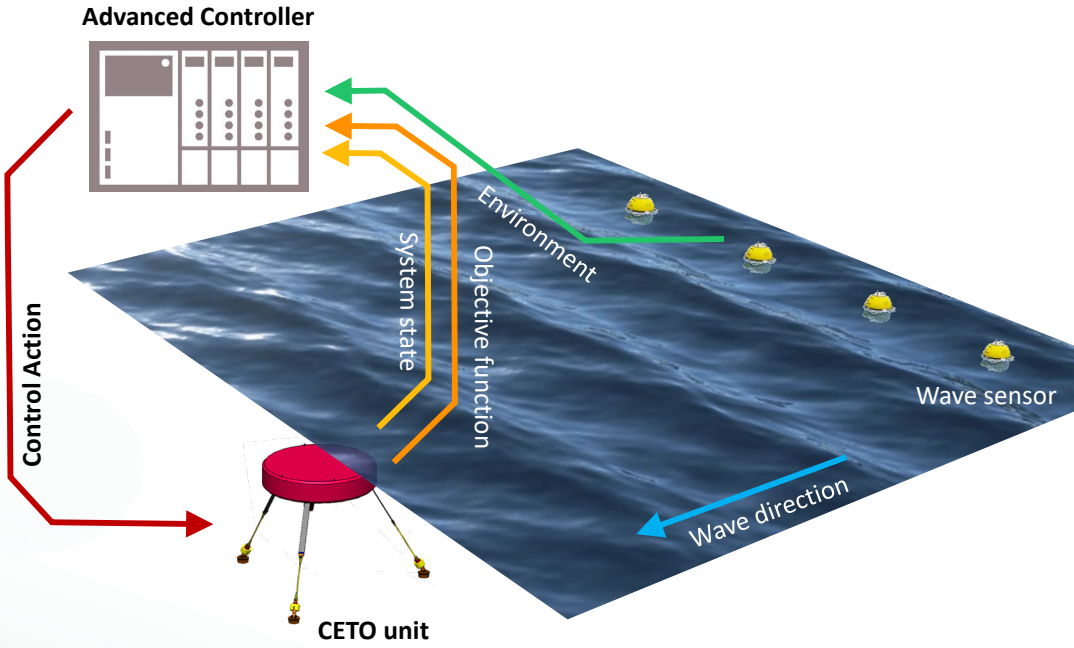
CETO Technology – Key Innovations

Advanced Controller

- Reinforcement Learning (RL) and Model Predictive Control (MPC) developed for CETO
- Includes wave predictor developed by Carnegie and tested at IHC
- Yield >20% compared to passive controller
- Controller to be physically tested during Phase 2 tank campaign



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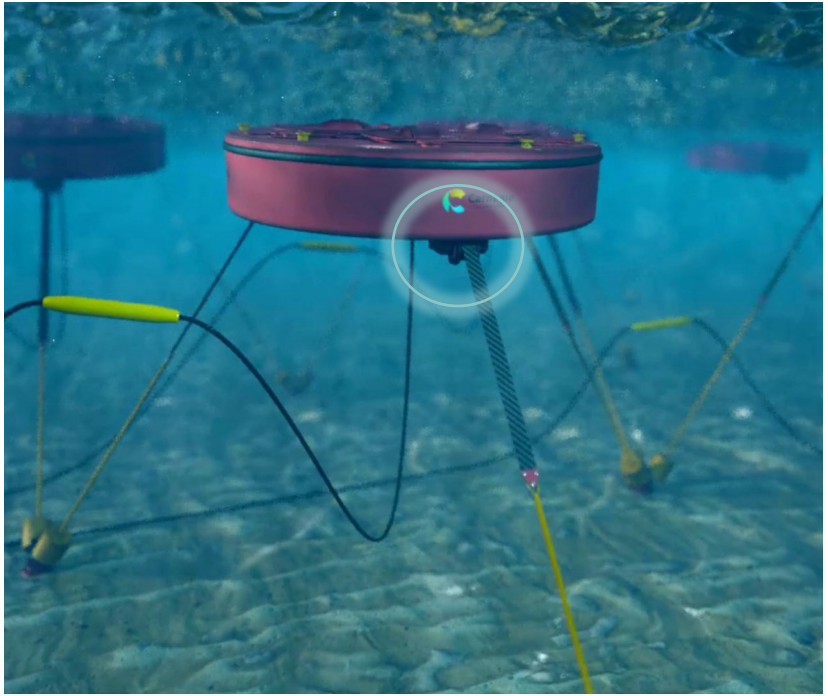
CETO Technology – Key Innovations

Rotary Electric PTO

- Belt wraps on a drum driving mooring tensioner and electrical drive train
- Allows direct control of the force applied in each mooring enabling advanced controllers
- Offers direct energy conversion, leading to excellent efficiencies
- Simpler system with low part count for improved reliability
- Benefits from cost reductions achieved for electrical drive trains in other industries (offshore wind, EVs)
- Can easily accommodate large motions avoiding to design for end of stroke loads



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CETO Technology - Key target applications

Remote & Islands

Demand Applications

Utility Scale

High electricity tariff
High carbon (diesel) intensity and hard to abate
Potential value for additional benefits
Limited space/land availability
Hybrid systems

Low electricity tariff
Highly competitive
Enormous market size

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Phase 1 - Outline of activities and Project Team

		WP 1 Project Mngt	WP2 Concept Design	WP3 Num. Model Validation	WP4 Tank Testing	WP5 Operational Planning	WP6 Technology Roadmap	WP7 Financial Modelling	WP8 Certification Pathway
Consortium Members	CETO WAVE ENERGY IRELAND	Leading	Leading	Supporting	Supporting	Leading	Supporting	Supporting	Supporting
	saitec offshore technologies	Supporting	Supporting			Supporting	Supporting		
Subcontractors	YAVIN FOUR CONSULTANTS		Supporting	Leading			Leading		
	DNV								Leading
	IH cantabria INSTITUTO DE HIDRÁULICA AMBIENTAL UNIVERSIDAD DE CANTABRIA				Leading				
	JULIA F. CHOZAS CONSULTING ENGINEER							Leading	

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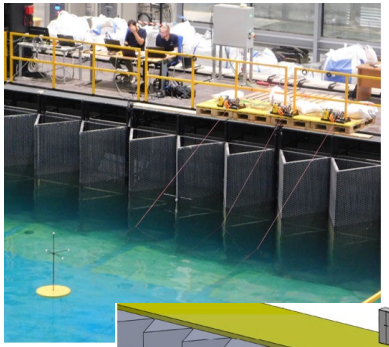
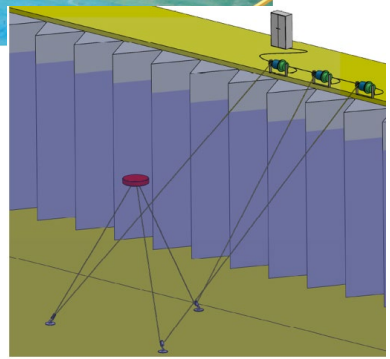
Phase 1 learnings

- Solid project base established with a thorough **Basis of Design**
- **System Architecture** suitable for **BiMEP** and **EMEC**
- Effective **mitigations for yaw** instability uncovered during phase 1
- Advanced controller fixed, ready to demonstrate **superior performance in tank**.
- Extra **preparation effort in tank** testing in Phase 1 to be helpful in reducing testing time for Phase 2





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Phase 1 learnings

- Excellent progress on **Components Design**, supplier engagement ramping up in phase 2
- Unique **Survival Strategy**, solving fundamental WEC challenge: peak/average
- **Validated Numerical Models** used to confirm **Performance**
- Clear **O&M plans** based on extensive operational expertise
- **System Engineering** and Project management best practices endorsed by **Classification Society**

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Phase 2 Activities and Team		WP 1 Project Mngt	WP2 FEED	WP3 Numerical Modelling	WP4 Tank Testing	WP5 PTO Testing	WP6 Operational Planning	WP7 Financial Modelling	WP8 Certification Pathway
Consortium Members	CETO WAVE ENERGY IRELAND	Leading	Leading	Leading	Supporting	Leading	Leading	Supporting	Supporting
	saitec offshore technologies	Supporting	Supporting				Supporting		
Subcontractors	HUTCHINSON BELT DRIVE SYSTEMS		Supporting			Supporting			
	Hewlett Packard Enterprise		Supporting		Supporting				
	IH cantabria INSTITUTO DE HIDRÁULICA AMBIENTAL UNIVERSIDAD DE CANTABRIA				Leading				
	VGA		Supporting			Supporting			
	JULIA F. CHOZAS CONSULTING ENGINEER							Leading	
	DNV YAVIN FOUR CONSULTANTS								Leading

Phase 2 objectives

- Completion of **FEED** for all main subsystems
- Validation of the **refined numerical models**
- Successful **testing of the advanced controls** in tank
- Successful testing of **survivability** capabilities in tank
- Successful testing of the **PTO** (Mooring Tensioner, belt, ...)
- Refining of marine operation plans
- Refining of techno-economic assessment
- Update FMECA and technology and **risk** registers
- Independent **third-party validation** of the technology analysis
- Progress along the **certification pathway**

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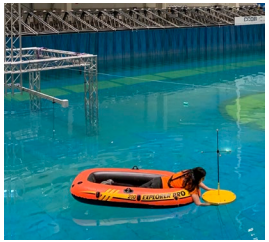
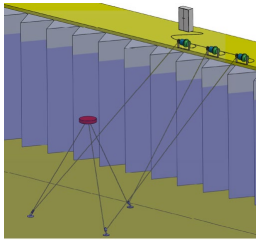
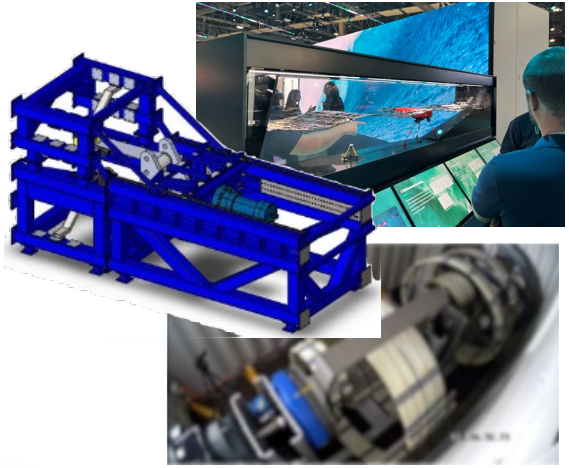
Phase 2 most relevant progress

- Progressed on the **FEED**: BA update, Mooring Connector, secondary mooring, …
- **Improved system architecture and control** have overcome potential yawing issues
- Good progress on **RL implementation** by HPE
- **Tank testing** in progress at IHC (controls + survivability)
- **PTO testing**: parallel Mooring Tensioner testing; engagement with VGA for the belt testing set-up; Hutchinson for fatigue characterisation
- Incorporating a new electrical engineer to the Project team







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